1. Subbasin Assessment – Watershed Characterization

The federal Clean Water Act (CWA) requires that states and tribes restore and maintain the chemical, physical, and biological integrity of the nation's waters (33 USC § 1251.101). States and tribes, pursuant to section 303 of the CWA, are to adopt water quality standards necessary to protect fish, shellfish, and wildlife while providing for recreation in and on the waters whenever possible. Section 303(d) of the CWA establishes requirements for states and tribes to identify and prioritize water bodies that are water quality limited (i.e., water bodies that do not meet water quality standards). States and tribes must periodically publish a priority list of impaired waters, currently every two years. For waters identified on this list, states and tribes must develop a total maximum daily load (TMDL) for the pollutants, set at a level to achieve water quality standards. This document addresses the water bodies in the Raft River Subbasin that have been placed on what is known as the "§303(d) list."

The overall purpose of this subbasin assessment (SBA) and TMDL is to characterize and document pollutant loads within the Raft River Subbasin. The first portion of this document, the SBA, is partitioned into four major sections: watershed characterization, water quality concerns and status, pollutant source inventory, and a summary of past and present pollution control efforts (Chapters 1 – 4). This information will then be used to develop a TMDL for each pollutant of concern for the Raft River Subbasin (Chapter 5).

1.1 Introduction

In 1972, Congress passed public law 92-500, the Federal Water Pollution Control Act, more commonly called the CWA. The goal of this act was to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters" (Water Pollution Control Federation 1987). The act and the programs it has generated have changed over the years as experience and perceptions of water quality have changed. The CWA has been amended 15 times, most significantly in 1977, 1981, and 1987. One of the goals of the 1977 amendment was protecting and managing waters to insure "swimmable and fishable" conditions. This goal, along with a 1972 goal to restore and maintain chemical, physical, and biological integrity, relates water quality with more than just chemistry.

Background

The federal government, through the U.S. Environmental Protection Agency (EPA), assumed the dominant role in defining and directing water pollution control programs across the county. The Department of Environmental Quality (DEQ) implements the CWA in Idaho, while the EPA oversees Idaho and certifies the fulfillment of CWA requirements and responsibilities.

Section 303 of the CWA requires DEQ to adopt, with EPA approval, water quality standards and to review those standards every three years. Additionally, DEQ must monitor waters to identify those not meeting water quality standards. For those waters not meeting standards, DEQ must establish TMDLs for each pollutant impairing the waters. Further, the agency must set appropriate controls to restore water quality and allow the water bodies to meet their designated uses. These requirements result in a list of impaired waters, called the "§303(d) list." This list describes water bodies not meeting water quality standards. Waters identified on this list require further analysis. A SBA and TMDL provide a summary of the water quality status and allowable TMDL for water bodies on the §303(d) list. *The Raft River Subbasin Assessment and Total Maximum Daily Loads* provides this summary for the currently listed waters in the Raft River Subbasin.

The SBA section of this report includes an evaluation and summary of the current water quality status, pollutant sources, and control actions in the Raft River Subbasin to date. While this assessment is not a requirement of the TMDL, DEQ performs the assessment to ensure impairment listings are up to date and accurate. The TMDL is a plan to improve water quality by limiting pollutant loads. Specifically, a TMDL is an estimation of the maximum pollutant amount that can be present in a water body and still allow that water body to meet water quality standards (40 CFR part 130). Consequently, a TMDL is water body- and pollutant-specific. The TMDL also includes individual pollutant allocations among various sources discharging the pollutant. The EPA considers certain unnatural conditions, such as flow alteration, a lack of flow, or habitat alteration, that are not the result of the discharge of specific pollutants as "pollution." TMDLs are not required for water bodies impaired by pollution, but not specific pollutants. In common usage, a TMDL also refers to the written document that contains the statement of loads and supporting analyses, often incorporating TMDLs for several water bodies and/or pollutants within a given watershed.

Idaho's Role

Idaho adopts water quality standards to protect public health and welfare, enhance the quality of water, and protect biological integrity. A water quality standard defines the goals of a water body by designating the use or uses for the water, setting criteria necessary to protect those uses, and preventing degradation of water quality through antidegradation provisions.

The state may assign or designate beneficial uses for particular Idaho water bodies to support. These beneficial uses are identified in the Idaho water quality standards and include:

- Aquatic life support – cold water, seasonal cold water, warm water, salmonid spawning, modified

- Contact recreation – primary (swimming), secondary (wading)

- Water supply – domestic, agricultural, industrial

- Wildlife habitats, aesthetics

The Idaho legislature designates uses for water bodies. Industrial water supply, wildlife habitat, and aesthetics are designated beneficial uses for all water bodies in the state. If a water body is unclassified, then cold water and primary contact recreation are used as default uses when water bodies are assessed and until beneficial uses can be designated for them.

A SBA entails analyzing and integrating multiple types of water body data, such as biological, physical/chemical, and landscape data, to address several objectives:

- Determine the support status of the designated or default beneficial uses of a water body (i.e., attaining or not attaining water quality standards).

- Determine the degree of achievement of biological integrity.

- Compile descriptive information about the water body, particularly the identity and location of pollutant sources.

- When water bodies are not attaining water quality standards, determine the causes and extent of the impairment.

1.2 Physical and Biological Characteristics

The Raft River SBA is a problem assessment conducted at the geographic scale of fourth field hydrologic units (cataloging units of the U.S. Geological Survey [USGS]), also referred to as a subbasins (Figure 2). This SBA describes those water bodies in fourth field Hydrologic Unit Code (HUC) 17040210 listed on DEQ's 1998 §303(d) list. This SBA describes the Raft River Subbasin and addresses the water quality concerns and status of beneficial uses of §303(d) water bodies, the nature and location of pollution sources, and past and ongoing pollution control activities on §303(d) water bodies. Six watersheds, or fifth field HUCs, in the subbasin contain the §303(d) listed streams are listed in Table 4 and shown in Figure 3.

Table 4. DEQ 1998 §303(d) list, HUC No. 17040210.

Water Body	Boundaries	Stream Length
Raft River	Malta to Snake River	54.6 kilometers
Raft River	Utah Line to Malta	67.9 kilometers
Sublett Creek	Sublett Reservoir to lower boundaries	13.3 kilometers
Sublett Reservoir	The Reservoir	0
Cassia Creek	Conner Creek to Raft River	20.5 kilometers
Fall Creek	Headwaters to Lake Fork	3.7 kilometers

For a Map View, See Figure 3. Raft River Subbasin 1998 §303(d) listed water bodies

Information concerning U.S. Forest Service (USFS) lands (Figure 4) contained in the following descriptions was obtained from the United States Department of Agriculture Forest Service *Sawtooth National Forest Draft Land Management Plan* (USFS 2000).

The Raft River Subbasin is located in the eastern part of Cassia County, Idaho, and the northern part of Box Elder County, Utah. Raft River originates in USFS lands in the Raft River Mountain Range, which lies just south of the Idaho-Utah border. About 70 percent of the area drains north into the Raft River Subbasin through the Junction Creek, Barnes-Wildcat, and Upper Clear Creek Watersheds. The Raft River flows in a northeasterly direction from its headwaters in Utah, terminating at Lake Walcott on the Snake River. The city of Burley lies 56 kilometers (km) (35 miles) to the west of the mouth of the Raft River with the city of Pocatello lying 76 km (47 miles) to the east.

Other USFS management areas besides the Raft River area that drain into the Raft River Subbasin are part of HUC 17040210 and include Black Pine, Sublett, and Independence Lakes. The Black Pine USFS lands in the Black Pine Mountain Range lie in the western end of Cassia County, Idaho. The area is an estimated 31,080 hectare (76,800 acres), which includes several small private holdings totaling 1,174 hectare (2,900 acres). Private ranches or U.S. Bureau of Land Management (BLM) lands border most of the area. The primary uses and activities in the area are livestock grazing, timber management, dispersed recreation (mainly hunting), and mining. Pegasus Gold, a large gold mine, operated on the east side of the Black Pine Mountains for several years. The western half of the area drains west into the Raft River Subbasin. The eastern portion of the area drains east into the Curlew Valley Subbasin and then south into the

Great Salt Lake Basin. Two perennial streams exist, both in the western portion of the area: Eightmile Creek and Sixmile Creek. Sixmile Creek flows into a small reservoir that is used for irrigation below the USFS boundary. Most canyons feature intermittent streams that flow only during spring snow melt and periods of severe or sustained thunderstorms in the summer months. Neither of the two streams, Eightmile Creek or Sixmile Creek, reaches the Raft River nor are they listed on the §303(d) list.

The USFS management unit of Sublett lies in Cassia and Power Counties, Idaho. This area is an estimated 31,667 hectares (78,250 acres), which include several small private holdings totaling 251 hectares (620 acres). Most of the bordering lands are private ranches and BLM lands. The majority of the private land has been converted to agriculture. The primary uses and activities in the forestlands have been livestock grazing, public recreation, and timber management.

The majority of irrigated lands lie very near Sublett Creek, while dry farming agriculture predominates elsewhere in the Sublett Watershed. The Sublett USFS area is comprised of portions of six watersheds that drain into three separate subbasins. About 70 percent of the area drains west into the Raft River Subbasin through the Sublett Creek. This subbasin will be addressed in this SBA. The eastern portion of the area drains east into the Lake Walcott Subbasin through the Rockland area and has been addressed in the Lake Walcott TMDL on the Rock Creek Subbasin. The southern tip (less than 1 percent) drains south into the Curlew Valley Subbasin through the Juniper Valley Watershed. The main perennial streams in the area are the Lake Fork, North Fork, and South Fork of Sublett Creek. There are no natural lakes in the area. Most of the other streams run intermittently. Sublett Reservoir is located at the south end of the area; most of the reservoir is contained on private lands. Sublett Reservoir, Sublett Creek below the reservoir, and Fall Creek are listed on the 1998 §303(d) list.

The last of the USFS lands that drain into the Raft River Subbasin are the Independence Lakes area on the east side of the HUC. The land is on the eastern side of the Albion Division of the Minidoka Ranger District. The entire area is in Cassia County and is estimated at 69,685 hectares (43,300 acres), including one private land holding of 1,006 hectares (625 acres), and a patented mining claim in the Connor Creek drainage. The City of Rocks National Reserve lies adjacent to the southern portion of the management area. The area is bordered by the Sawtooth National Forest to the west and north and primarily private ranch lands to the east. The primary uses and activities in this management area are livestock grazing and dispersed recreation. At 3,170 meters (m) (10,399 feet[ft]), Cache Peak is the highest mountain in Idaho south of the Snake River. Portions of the Mountain Harrison and Cache Creek Natural Inventoried Roadless Areas lie within the management area. The Mount Harrison Research Natural Area (154 hectare, 381 acres) has been established in the northwest corner of the management area to preserve rare plant species and to serve as a representation of relatively undisturbed subalpine vegetation. Segments of Clyde Creek, Stinson Creek, and Almo Creek are potentially eligible for Wild and Scenic River designation (USFS 2000).

The Cassia Creek, Edwards Creek, and Grape Creek Watersheds drain east into the Raft River Subbasin. The main streams in the area are Green Creek, Clyde Creek, New Canyon Creek, Stinson Creek, Almo Creek, Conner Creek, and Cassia Creek. Cassia Creek is listed on the 1998 §303(d) list.

For the USFS lands surrounding the Raft River Subbasin (Idaho and Utah) the two dominant subsections are the Humboldt River High Plateau and Jarbidge High Mountain Ranges. The dominant landforms are glaciated mountains, fluvial mountains, plateaus, escarpments, and depositional lands. Slope gradients average 40 to 70 percent on the glaciated mountains and the fluvial mountains, 0 to 30 percent on the plateaus and depositional lands, to near vertical on the escarpments. The surface geology is predominantly granitic, with minor intrusions of basalt and sandstone. Soils generally have moderate erosion potential and moderate productivity. Shallow soils at higher elevations (2,591-3048 m [8,500-10,000 ft]) are susceptible to impacts from livestock grazing. Geomorphic integrity is at high risk due to impacts from roads, livestock grazing, and dispersed recreation. Impacts include accelerated erosion, upland compaction, and stream bank and channel modification (USFS 2000).

Subbasin Ecoregion Description

The Raft River Subbasin is also described according to its ecoregion (or ecozone). An ecoregion is an ecological area that has similarities in plant and animal species, climate, soil, and the general topography of the landscape. The ecoregion is also a broad description of the subbasin. The Raft River ecoregions are described by the Omernik-Gallant method (EPA1986). The Omernik-Gallant method characterizes the Raft River Subbasin as two ecoregions: the Northern Basin and Range ecoregion and the Snake River Basin/High Desert ecoregion. The Snake River Basin/High Desert ecoregion makes up 17.5 percent (68,700 hectares; 169,761 acres) of the subbasin, whereas the Northern Basin and Range ecoregion makes up 82.5 percent (323,106 hectares; 793,467 acres) of the subbasin (Figure 5). The Snake River Basin/High Desert ecoregion has Sawtooth National Forest lands under four distinct management areas, with BLM, state, and private lands dispersed throughout the ecoregion. The Northern Basin and Range ecoregion on the north end of the subbasin includes BLM, private, and state lands and borders the Snake River/Lake Walcott Subbasin. The Bailey/McNab-Avers method (USFS 1986) characterizes the Raft River Subbasin similarly: the Intermountain Semidesert ecoregion (Province 342) and the Northwestern Basin and Range (Province 342B) (Tables 5 and 6).

Table 5. Compilation of the Omernik-Gallant and Bailey/McNab-Avers ecoregions.

Typical Land Form	Typical Vegetation	Typical Land Use	Soils
Northern Basin and Range Ecoregion			
Plains with low to high mountains and open high mountains. Nearly level basins and valleys are bordered by long, gently sloping alluvial fans with north-south trending mountain ranges	Great basin sagebrush, sagebrush steppe, wheat grass, saltbush, greasewood, shrub-grass, sedges and forbs line the riparian zone.	Livestock grazing of desert shrubland, agriculture uses include dryland farming, some irrigation farming, and recreation.	Aridisols and aridic Mollisols, along with xeric and aridic soil moisture regimes.
SNAKE RIVER BASIN/HIGH DESERT			
Tablelands with moderate to high relief, plains with hill or low mountains, north-south trending mountains	Sagebrush-steppe (sagebrush, wheat-grass) saltbrush, wheatbrush. North and east aspects support aspen and subalpine fir communities with a Douglas fir component.	Grazing on the desert shrubland and lower open forest lands, dry and irrigated farming, recreation, some mining.	Aridsols

Table 6. Percent of subbasin within each ecoregion.

Ecoregion	Acres	SqMiles	% of Area
Snake River Basin/High Desert	169,761.4	265.3	17.5
Northern Basin and Range	798,410.8	1,247.5	82.5

Subbasin Meteorology

The climate in the Raft River Subbasin is semi-arid with cool, moist winters and warm, dry summers. Three climate stations of the Western Regional Climate Center (Western Regional Climate Center 2001), along with the U.S. Department of Agriculture Natural Resource Conservation Service (NRCS) Howell Canyon, ID SNOTEL site best characterize the meteorological characteristics of the subbasin. The average annual precipitation ranges from 11 inches in the valley at the Malta and Strevell climate stations to nearly 40 inches in the mountains as measured at the automated Howell Canyon SNOTEL site. The Malta and Strevell sites were used to approximate the meteorological characteristics of the lower elevation area in the southern part of the subbasin. The Malta elevation is 1,300 m [4,589 ft] above sea level, the Strevell Site Elevation is 1,609 m [5,279 ft] above sea level, and within the higher elevation area the Howell Canyon SNOTEL site is at 2,432m [7,980ft] above sea level. This site was used to approximate meteorological characteristics of the higher elevations of the subbasin (SCS et al. 1991). The Minidoka Dam site elevation is 1,269 m, [4,163 ft] above sea level and is located in the Snake River Basin/High Desert ecoregion area. The northern area of the HUC along the Snake River is best described by the meteorological data from that site, Table 7.

Table 7. Climate description of which is shown in the Raft River Subbasin by ecoregion[a].

PRECIPITATION RANGE (Inches)	PRECIPITATION MEAN (Inches)	MOST PRECIPITATION (by season)	MEAN ANNUAL AIR TEMPERATURE RANGE	GROWING SEASON[b] (Days)
Snake River Basin/High Desert (Province 342): Lower Elevation				
Minidoka Dam Site: 9 to 12 in[c]	9.54	Fall, winter, spring	1.89 ºC (35.4 ºF) to 15.9 ºC (60.7 ºF)	60 - 120
Northwestern Basin and Range (Province 342b):Southern Plains And Higher Elevations				
Malta 2 E Site:	10 - 15	11.28 in	32.3 ºC (62.4 ºF) to 0.19 ºC (0.17 ºF)	70 - 100
Howell Canyon Snotel Site: 28 - 45 inches	37.6	Fall, winter spring	-9.4 ºC (15 ºF) to 23.9 ºC (75 ºF)	Not applicable

[a] Natural Resource Conservation Service 2001, and Western Regional Climate Center 2001.
[b] These figures are based on the 50% probability of a killing (-2.2ºC or 28ºF) freeze occurring on or after a particular date in the spring or on or before a particular date in the fall (IDWR 1972). Frost-free precipitation is based on frost-free period of record.
[c] in = inches.

Subbasin Precipitation/Snowfall

The average annual precipitation is approximately 11 inches in the valley at the Malta and Strevell climate stations. The GIS coverages (Figure 6) also indicate that the valleys average between 11 to 15 inches per year. Use of the Strevell station was discontinued in 1986. However, the Malta site is still in use. Precipitation is evenly distributed throughout the year at the lower elevations with a slight increase in spring and summer. At higher elevations, winter precipitation predominates, while the summers are typically dry and cool. This is due to the importance of summer convectional storms in the valley as contrasted with the strong orographic effects of the mountains on winter frontal systems (SCS et al. 1991). Normal precipitation during the growing season (April-September) averages about 7 inches at the two valley stations.

In the subbasin, snowfall is a major component of total precipitation. Over half the precipitation falls as snow in the months of November to mid-April. Except for the wettest months of December and January, the monthly mean precipitation is evenly distributed throughout the year. Along with the USDA NRCS Howell Canyon SNOTEL site, nine manually measured snow courses have provided data on the depth and water equivalence of the winter and spring snowpack. The mountain snowpack usually reach their maximum water content in early April before the melting season begins. The long term average snow depth on April 1 for the nine snow courses ranges from 25 to 86 inches, and the average April 1 water content for these sites ranges from 7.4 to 29.9 inches. There is an 80 percent chance that the April 1 snow water content will be approximately 75 percent or more of the average April 1 values. In some years the May 1 snow water content is the maximum, mainly at the higher elevation sites in above normal snow years (SCS et al. 1991).

Subbasin Air Temperature

For this report, ambient temperature is reported in three ways: monthly maximum daily average, minimum monthly average, and the calculated average monthly mid-range. As a whole, ambient monthly temperatures increase from the Sawtooth National Forest areas towards the valley and agriculture areas (Figure 7). In general, the highest monthly average temperatures and the highest mid-range average temperatures occur during the months of June through September. The average lowest monthly temperatures and the lowest mid-range average temperatures occur during the months of November through March (Table 8).

Table 8. Average annual temperatures by general elevation area. White Horse Associates 1999.

GENERAL ELEVATION AREAS	AVERAGE ANNUAL TEMPERATURE RANGE[a]	
	CELSIUS °C	FAHRENHEIT °F
Sawtooth National Forest, highest elevation	-1.1 - 1.6	30 - 34.9
Highlands, forest and hills	1.7 - 4.39	35 - 39.9
Uplands to valley floors	4.4 - 7.17	40 - 44.9
Floodplains and valley floors	7.2 - 9.9	45 - 49.9

[a] The average annual temperature range as calculated for the various elevations ranges and areas by White Horse Associates 1999. See Figure 7.

Subbasin Wind Erosion

In the Snake River Basin of southern Idaho wind erosion occurs most frequently on single-grain textured soils where there are smooth surface conditions and a lack of crop residue or cover from fall planted crops. Wind erosion primarily occurs during the spring months when wind velocities are highest in the Snake River Plain area (NRCS 1998) of the Raft River Subbasin. It is the maximum wind speeds and gusts that move the loessal soil particles through the air to eventually settle on new territory, streams, and vegetation. It is uncertain to what extent erosion seasonally affects water quality on the §303(d) streams in the Raft River Subbasin. Based on regional estimates of uncovered single-grain textured soils, soil texture, and wind velocities, wind erosion's effect on water quality is not significant beyond a minimum amount of suspended sediment affecting water quality on an annual average basis. A localized problem with wind erosion as a resource problem; however, has been evident as related to Interstate 84 that passes through the area. Numerous deadly accidents have been related to blowing snow and soil. The section of Interstate 84 in the watershed has been considered one of the deadliest stretches of interstate in the country (SCS et al. 1991). Living snow fences and automated interstate warning signs have been installed, and soil conservation best management practices (BMPs) on land adjacent to the interstate have been implemented to help reduce the wind related problems.

Subbasin Hydrology

The natural hydrology of the Raft River Subbasin is related to its climate regime, topography, and geology. Many physical processes such as rainfall, streamflow, erosion, and sedimentation interact within the watershed boundaries to shape and form the landscape. The various watersheds in the Raft River Subbasin are natural divisions of the landscape and the basic functioning units of hydrologic systems. These watersheds are also hierarchical – smaller ones nest within larger ones. Landforms are also hierarchical; the valleys nest within watersheds and their natural form is part of the geologic history and physical and biological characteristics of the watershed. The hydrologic cycle links atmospheric water, surface water, and ground water control the distribution and movement of water in an ecosystem (USFS 1997). The history of natural and human disturbances along with environmental changes in the Raft River Subbasin has effected the hydrology of the region. Among the more observable changes, disturbance, compaction of soil, and changes in riparian areas are altering the relationships between infiltration, soil moisture storage, ground water recharge, surface runoff, flood control, and stream flows (USFS 2000). Depending on the location, one of these components may have a greater effect over another on the water quality and quantity of the Raft River, Cassia Creek, and Sublett Creek area tributaries. In general, water bodies within the Raft River Subbasin may be categorized into perennial, intermittent, or ephemeral water bodies.

A perennial stream is one that flows year-round in most years. Idaho's administrative ruiles do not define perennial streams, but by default a perennial stream is a stream that is not ephemeral or intermittent. An intermittent stream, as defined in IDAPA 58.01.02.003.50, is a stream that has a period of zero flow for at least one week during most years. Where flow records are available, a "stream with 7Q2 hydrologically based design flow of less that one-tenth (0.1) cfs is considered intermittent. Streams with perennial pools, which create significant aquatic life uses, are not intermittent." Ephemeral streams are streams that function as drainage channels that are normally dry but carry water in response to storms or annual snowmelt (Figure 8).

Subbasin Fifth Field HUC Characteristics

The Raft River Subbasin is hydrologically subdivided into 21 watersheds (or fifith field HUCs). These are listed in Table 9 with their appropriate number, name, and size and shown in Figure 9.

Table 9. Fifth field HUCs of the Raft River Subbasin 17040210.

Fifth Field Number	Watershed Name	Total Hectares	Fifth Field Number	Watershed Name	Total Hectares
[17040210] 01	Lower Raft River	78,126	[1700210]12	Upper Raft River	13,847
02	Shirley-Warm	12,062	13	Circle-Wildcat	11,983
03	Sublet Creek	5,002	14	Junction Creek	17,089
04	Clear Creek	19,167	15	Cottonwood Creek	20,173
05	Sublett Creek	20,853	16	Edwards Creek	11,585
06	Meadow Creek	24,254	17	Grape Creek	7,466
07	Kelsaw-Point Spring	28,149	18	Upper Cassia Creek	16,802
08	Clear-Holt	20,337	19	Cassia-Blacksmith	8,394
09	Round Mountain Creek	15,611	20	Upper Cassia Creek	3,905
10	Barnes-Onemile	12,576	21	Lower Cassia Creek	16,888
11	Johnson-George	27,426			

The Raft River System

The Raft River is the major stream draining the subbasin (HUC 17040210). It was once considered a perennial stream that was fed during periods of high runoff by numerous intermittent, ephemeral, and perennial streams. The natural surface outflow from the basin, based on measurements of the Raft River as early as 1910, is estimated to have averaged about 17,000 acre-feet per year (Walker et al. 1970). Considerably greater amounts of flow also occurred in the subbasin east of the Cotterel Range. That flow included an average annual inflow of about 18,000 acre-feet from Cassia Creek, 24,000 acre-feet from the Raft River at The Narrows, 8,400 acre-feet from creeks draining the Raft River Mountains, and 5,400 acre-feet from creeks rising in the Sublett Range. This average total inflow was about 56,000 acre-feet. Most of this water contributed to recharge of the ground water reservoir or was consumed by natural riparian ecosystems. However, certain reaches of the Raft River and its tributaries are now intermittent due to flow diversions for irrigation purposes (Walker et al. 1970). Flow into the Lake Walcott Subbasin from the Raft River are no longer considered perennial. Landowners and managers within the Raft River Subbasin have noted that the Raft River, near the Snake River, does not flow in a majority of years during the summers due to irrigation demands (SCS et al. 1991)

Raft River Tributaries and Their Watersheds

Two main tributaries form the headwaters of Raft River in Junction Valley, Utah. The southern parts of the Middle Mountain range and the Albion Mountain range feed into southern flowing

Junction Creek. The Middle Mountain range ranges from a high elevation of 2,469 m (8,100 ft) to 1,745 m (5,725 ft) at the confluence with Raft River. The northern sections of both the Middle Mountain and Albion Mountain ranges feed a northerly flow into Birch Creek of the Goose Creek HUC (17040211). The southern section of the Albion Mountain range ranges from a high elevation of 2,703 m (8,868 ft) at Graham Peak to 1,740 m (5,709 ft) at the confluence with Raft River. The western flows of the City of Rocks and Cedar Hills areas have small intermittent or ephemeral flows into Junction Creek. The South Fork of Junction Creek flows north to the confluence of Junction Creek to form Raft River. The Grouse Creek Mountains feed into Raft River on the west and south. Elevations range from 2,075 m (6,807 ft) to 1,740 m (5,709 ft) at the start of Raft River. From the east water comes from the Dove Creek Mountains which range north into the Raft River Mountains of the Sawtooth National Forest. Marble Canyon Peak at 2,544 m (8,346 ft) and George Peak at 2,926 m (9,600 ft) are some of the higher elevations. Several small intermittent or ephemeral tributaries feed into the South Fork of Junction Creek or into the Raft River itself.

Major natural tributaries to the Raft River (using a 1:100,000 scale GIS coverage) are listed in Table 10 according to their river mile (RM) location on the Raft River in Idaho and from which bank they enter the Raft River.

Table 10. Natural tributaries to the Raft River.

Tributary Name	Bank Inputs	River Mile[a]	Elevation Levels		Headwater Area
			Confluence (meters)	Headwaters (meters)	
Junction Creek	Confluence	Utah	1,745	2,469	Middle Mountains
Junction Creek	Confluence	Utah	1,745	2,703	Albion Mountains
South Fork of Junction Creek	Confluence	Utah	1,745	2,926	Raft River Mountains
Lynn Creek	Right	Utah	1,742	2,230	Raft River Mountains
Big Pole Creek	Right	Utah	1,738	2,313	Raft River Mountains
Wild Cat Creek	Right	Utah	1,736	2,250	Raft River Mountains
Circle Creek	Left	70.8	1,570	1,804	Albion Mountains
Johnson Creek	Right	68.8	1,564	2,250	Raft River Mountains
Edwards Creek	Left	68.6	1,560	2,316	Albion Mountains
Grape Creek	Left	68.2	1,559	2,500	Albion Mountains
George Creek	Right	67.2	1,530	2,250	Raft River Mountains
Onemile Creek	Right	60.6	1,520	2,650	Raft River Mountains
Cottonwood Creek	Left	51.5	1,450	1,870	Jim Sage Mountains
Cassia Creek	Left	32.0	1,350	1,780	Albion Mountains

[a] Raft River Rivermile, Idaho Side Only

Tributaries to Cassia Creek That Flow from the Albion Mountains to the Raft River

Natural tributaries to Cassia Creek (using a 1:100,000 scale coverage) are listed in Table 11 according to the RM location on Cassia Creek.

Table 11. Named tributaries that feed into Cassia Creek.

Tributary Name	Bank Inputs	River Mile	Elevation Levels		Headwater Area
			Confluence (meters)	Headwaters (meters)	
New Canyon Creek	Left	22.5	1,814	2,000	Albion Mountains
Flat Canyon Creek	Right	22.5	1,814	2,000	Albion Mountains Headwaters of Cassia Creek
Stinson Creek	Right	20.5	1,752	2,365	Albion Mountains
Clyde Creek	Left	17.5	1,713	2,450	Albion Mountains
Conner Creek	Left	12.4	1,498	2,310	Albion Mountains

Tributaries to Sublett Creek Reservoir

Natural tributaries in the Sublett Reservoir/Creek area (using a 1:100,000 scale coverage) are listed in Table 12 according to the RM location on Sublett Creek.

Table 12. Named tributaries to Sublett Reservoir.

Tributary Name	Bank Inputs	River Mile	Elevation Levels		Headwater Area
			Confluence (meters)	Headwaters (meters)	
Fall Creek listed	Right	1.5 on Lake Creek	1,647	1,829	Flows to Lake Creek
Van Camp Creek	Right	0.5 on Lake Creek	1,638	1,750	Flows to Lake Creek
Lake Creek	-		1,627	1,836	Flows to Sublett Reservoir
South Fork of Sublett Creek	Left	0.0	1,661	1,989	Forms Sublett Creek
North Fork of Sublett Creek	Right	0.0	1,661	2,109	Forms Sublett Creek
Sublett Creek	-	2.0	1,630	1,661	Flows to Sublett Reservoir
Sublett Creek below Sublett Reservoir	-	-	-	1,613 Headgate elevation at Sublett Reservoir.	Flows from RM[a] 3.5 to approximately RM 12

[a] RM = River Mile

Raft River Subbasin Stream Lengths

It is estimated that approximately 504 km (313 miles) of perennial streams exist in the Raft River Subbasin. Various irrigation practices and diversions have changed parts of the Raft River so that much of the lower sections no longer flow as a perennial stream. Irrigation networks of canals and streams channels vary with availability of runoff flows and may not be used every year (Figure 10). Estimates based upon ArcView coverages provided by the Idaho Department of Water Resources (IDWR) and the EPA BASINS program indicate that there are 2,920.7 km (≅1,815 miles) of intermittent streams in the subbasin. Many of these streams are ephemeral and only function as drainage channels. These channels are normally dry and carry water only in response to storm events.

Subbasin Reservoirs and Natural Lakes

The Raft River Subbasin contains one man made reservoir developed primarily for agricultural water supply. In addition to this use the reservoir also supports recreation and aquatic life beneficial uses. The subbasin also contains several high mountain lakes. These lakes are primarily recreational water bodies as well as supporting aquatic life beneficial uses. Additional uses include grazing.

Sublett Reservoir

Sublett Reservoir is the only named reservoir in the Raft River Subbasin and is located in Management Area 20 of the Sawtooth National Forest lands in the Sublett Mountain Range. It is located in Cassia County and the area is administrated by the Sawtooth National Forest Minidoka Ranger District. The USFS lands are estimated at 78,250 acres. Less than 1 percent of this land is made of small private holdings, which are included in this total. The majority of the reservoir lies within these private land holdings. Private ranches and BLM lands surround the area US Forest Service administered lands. Most private lands have been converted to agriculture uses. Primary land uses in the USFS areas are livestock grazing, recreation, and timber management. The North and South Forks of Sublett Creek, along with Lake Fork, are the main perennial streams that feed Sublett Reservoir. Fall Creek feeds into Lake Fork and is listed on the §303(d) list. Most of the other streams run intermittently. Table 12, above, shows other tributaries in the area.

The elevation at the dam on Sublett Reservoir is 1,628 m, (5,341 ft.) the spillway is 1,626 m, (5,335 ft.) and the elevation at the headgate 1,613 m, (5,292 ft.). The reservoir covers approximately 80 acres. The reservoir offers fishing opportunities for rainbow trout, brown trout, cutthroat trout, and Kokanee salmon. Water storage in the reservoir provides irrigation water for downstream farms and ranches.

Rainbow trout and Yellowstone cutthroat trout are present in Sublett Creek, Lake Fork Creek, the North and South Forks of Sublett Creek, and Sublett Reservoir. Brown trout and kokanee salmon have been introduced to Sublett Reservoir and migrate up the streams to spawn. Fish habitat is limited elsewhere due to the small size and intermittent nature of area streams. Overall, aquatic habitat is functioning at low risk due to sedimentation impacts, grazing, and dewatering. Native cutthroat populations are at risk due to the presence of introduced fish species (USFS 2000).

Independence Lakes

Four small natural lakes lie near Cache Peak, which, at 3,170 m (10,399 ft.), is the highest mountain in Idaho south of the Snake River. Their general location lies on USFS lands on the western side of the Albion Division of the Minidoka Ranger District. The drainage of the lakes is in the upper Green Creek area, comprising the only system of natural lakes in the entire southern division of the Sawtooth National Forest. The area lies within Cassia County and has an estimated 43,300 acres. The City of Rocks National Reserve borders the southern portion of the area. Livestock grazing and recreation are the primary land use activities in the area. The Independence Lakes area is a popular recreation destination. The lakes have been planted with rainbow trout, cutthroat trout, California golden trout, and Arctic grayling. The four small lakes vary in size from 3.64 acres (southern most lake) to 4.47acres (next southern most lake) to 14.47 acres (largest lake) to 5.20 acres (northeast lake).

Subbasin Ground Water and Aquifers

The Raft River Subbasin includes subbasin aquifers, artesian springs, and various irrigation wells. Ground water in the Raft River Subbasin occurs in valley fill deposits, including the Pleistocene Raft Formation, the Holocene alluvium, and the upper part of the Apliocene Salt Lake formation. Most water is in the Raft River Valley, east of the Cotterell Range. The Raft River Subbasin is a major drainage subbasin tributary to the Snake River at Lake Walcott. Prior to development and use of its water resources by man, the basin contributed an estimated average 100,000 acre-feet of surface and subsurface flow to the Snake River system annually. Of the remaining estimated 140,000 acre-feet total annual water yield, about 40,000 acre-feet was consumed by riparian vegetation along stream channels (Walker et al. 1970). Some pumping of ground water for irrigation in the valley was started in the 1920s, but it was not until about 1950 that larger-scale pumping for irrigation developed. The ground water development was to supplement Raft River water shortages and to develop additional cropland. Mass production of deep wells for irrigation has adversely impacted the ground water supply. In 1963, IDWR declared the aquifer in the Raft River drainage a Critical Ground Water Area. The expansion of the area under protection continued until 1977, restricting deep well pumping. Studies indicated that annual ground water contribution from the basin (presumably to the Snake River) was 80,000 acre-feet/year, but that pumping withdrawals in excess of 105,000 acre-feet/year were endangering this flow and causing declining ground water tables (SCS et al. 1991). The Raft River Critical Ground Water Area of July 1977 is still current today (Harrington and Bendixsen 1999).

Most of the ground water suitable for irrigation development in the Raft River Subbasin occurs in the valley fill. The ground water is generally unconfined, and the several geologic formations constitute a single aquifer with a thickness exceeding 700 feet under most of the lowlands. Relatively impermeable rocks underlie this aquifer. West of the Cotterell Range, the same geologic formations are water bearing in the Yost-Almo and Elba watersheds. From these various watersheds there is outflow to the Raft River Valley through the alluvial valleys occupied by the Raft River and Cassia Creek as they traverse the Cotterell Range. The northern end of the subbasin is bordered by basalt which is highly permeable, but which includes massive impermeable rocks as well (Table 13) (EPA 2001).

Table 13. Raft River Subbasin aquifers.

Aquifer	Square Kilometers	Square Miles	Rock Type
Pacific Northwest basin-fill aquifers	2,481	958	Unconsolidated sand and gravel aquifers
No principal aquifer	730	282	N/A
Volcanic-and sedimentary-rock aquifer	251	97	Basalt and other volcanic-rock aquifers
Basin and Range aquifers	215	83	Unconsolidated sand and gravel aquifers
Snake River Plain aquifer system	158	61	Basalt and other volcanic-rock aquifers
Miocene basaltic-rock aquifers	18.1	7	Basalt and other volcanic-rock aquifers
Basin and Range carbonate-aquifers	2.59	1	Carbonate-rock aquifers

Major source: EPA 2001 Surf Your watershed (wysiwyg://2/http://www.epa.gov/surf2/hucs/17040210/).

Subbasin Geology

The Raft River Watershed is in the northern extension of the Basin and Range Province. The subbasin characteristically has steeply sloping mountain ranges and intervening wide, open valleys. As stated before, elevations range from 1,281 m (4,202 ft) at the confluence of Raft River with Lake Walcott to 3,150 m (10,335 ft) at the top of Cache Peak. The Raft River Valley is the largest in the watershed. Large, overlapping alluvial fans have developed along the surrounding mountains and extend to the valley floor. The Raft River floodplain is primarily located on the west side of the valley and varies in width from approximately 100 m wide in the southwest part in Utah to nearly 3 km in the Malta area. The Sublett and Blackpine Mountains on the eastern side of the watershed are primarily composed of limestone with some quartzite and sandstone. The central area Cotterel and Jim Sage Mountains are rhyolite and the western area Albion and Middle Mountain highlands have large components of mica schist, quartzite, and some granodiorite (SCS et al. 1991).

As stated before, the overall geologic structure of the area lies within the north to south oriented Basin and Range Province. The northern sections of the Raft River Subbasin are crosscut east to west by the Snake River Plain. Locally thick deposits of loess (wind-blown silt) overlie these rocks, particularly in the volcanic Snake River Plain (Alt and Hyndman 1989). The Basin and Range is an area of faulted metamorphic and sedimentary rocks uplifted into mountains, separated by basins deeply filled with alluvium. The Snake River Plain is a deep, wide, structural basin filled with a veneer of volcanic basalt deposits overlying rhyolite (Alt and Hyndman 1989). The rocks decrease in age, from west to east, due to migration of a magma source to the location of present-day Yellowstone National Park.

The northern section of the Raft River Subbasin lies on large basalt flows. Because less than one fourth of the surface area is bare rock, it probably belongs to the oldest group of the younger basalt flows. Geologists broadly classify the younger lava flows on the Snake River Plain into approximate age groups according to the amount of rock still without soil cover. These flows are described as, youngest flows, more than 75 percent exposed; intermediate flows between 25 and

75 percent exposed; and older flows, less that 25 percent exposed. The oldest flows are completely covered with soil and plants and are not usually exposed (Alt and Hyndman 1989).

The main valley of the Raft River Subbasin contains a deep fill of sedimentary and volcanic rocks, which likely accumulated during the latest Miocene and Pliocene Epochs. The deposits include silt, sand, gravel, mudflows, lakebed sediments, and volcanic ash. There are also areas of erupted rhyolite and basalt. The Miocene and Pliocene Epochs were 2.5 to 3 million years ago. During the Miocene Epoch, a giant meteorite struck southeastern Oregon, and the Basin and Range faulting began. The Columbia Plateau was formed and the Snake River Plain started across southwestern Idaho. The Pliocene Epoch that followed had volcanic hotspots migrating northeast, leaving the Snake River Plain in its wake. The valley-fill sediments in the Raft River Subbasin hold substantial geothermal energy likely from volcanic activity heating the rocks beneath the valley floor (Alt and Hyndman 1989). The area near the Idaho Raft River Narrows is considered volcanic plateau land. Above The Narrows, the area is mixed alluvial land. Current landscapes in the subbasin began developing in the middle and late Cenozoic period. “Late Tertiary events, largely the result of crustal extension, include folding and faulting to form the present mountains, sediment-filled basins, and local rhyolite volcanism. The folding produced the Sublett, Black Pine, Albion, Middle, and Cassia ranges”(SCS et al. 1991). The middle Cenozoic Era contains the Miocene (earlier) and the Pliocene (later) Epochs described above. The later part of the Cenozoic Era, in the period called Pleistocene, was when the Yellowstone volcano begin to erupt (about 1.8 – 0.6 million years ago). The later part of this period (considered the present) was the end of the desert climate, and modern streams began to flow in the region. Between this period to the present an early ice age existed, about 70,000 to 130,000 years ago. The last ice age ended about 10,000 years ago (Alt and Hyndman 1989).

As stated before, large alluvial fans exist throughout the Raft River Subbasin and are dissected by streams in some areas. Typically, in dry desert regions where sudden floods of runoff follow occasional heavy rains, enormous loads of sediment are deposited. This sediment is left behind in fans shaped like segments of cones laid out on the flanks of the mountains. This geology is evident on the Sublett and Black Pine Mountains and other areas in the watershed.

As climates change and wetter periods develop, increased plant cover helps prevent the catastrophic soil erosion and floods of surface runoff typical of deserts. Reduction of the rate of soil erosion by plants tends to foster clear streams that tend to erode their beds rather than deposit sediment. As the amount of rain and snowmelt increases, proportionally there is more water available to soak into the ground because of increased plant coverage. Consequently, there are expanded reservoirs of stored ground water. This stored ground water is then available to keep streams flowing throughout dry seasons. These perennial streams erode valleys in alluvial fans, instead of covering them with new blankets of sediment. The dissected alluvial fans indicate that the amount of rainfall has varied significantly over the recent geologic past. During dry periods, the fans probably grew and existed between ice ages. The various ice ages probably brought on wet periods, perennial streams, and head cutting through the fans.

The Cotterel and Jim Sage Mountains have rhyolite flows as their parent material. As uplifting occurred, the brittle rhyolite fractured allowing water to erode deep, V-shaped, narrow canyons. The canyons formed by this process are 300 to 400 feet deep in the Cotterel Mountains and some approach 1,000 feet deep in the Jim Sage Mountains. The Jim Sage Mountains have a pronounced fault scarp with exposed dark lava flows capping steep grassy slopes on pale rhyolite. The Black Pine and the Sublett Mountains, as stated before, are primarily of limestone with some sandstone and quartzite. These ranges have eroded rapidly causing numerous, V-shaped, steep-sided, narrow valleys. The Albion and Middle Mountains have large deposits of mica schist and quartzite. Because of slower weathering of these materials, the mountains are rounder and smoother in appearance. Narrow V-shaped valleys only exist along major drainages.

Table 14 has a geologic description for the various formations and Figure 11 gives a breakdown of the Idaho sections of the Raft River Subbasins geology.

Table 14. Geologic descriptions for various formations.

Formation	Raft River Subbasin Geologic Descriptions
Ms	Mississippian shallow-water coralline limestone interval of southern Idaho
O	Ordovician marine dolomite quartzite and limestone
OCm	Schist quartzite and other metasediments of probable Lower Ordovician
OW	Open Water
PC	Precambrian high-grade metamorphic rocks
PNs	Pennsylvanian beds; lowermost portion of southern Idaho sequence
PPNs	Lower Permian to Middle Pennsylvanian chert limestone and sandstone
PZu	Upper Paleozoic marine sediments in southern Idaho
Ps	Lower Permian beds; uppermost portion of southern Idaho sequence
QTb	Lower Pleistocene to Pliocene basalts with associated tuffs and volcanic detritus
Qa	Quaternary alluvium
Qd	Quaternary detritus
Qg	Quaternary colluvium fanglomerate and talus
Qpt	Pleistocene till moraines and similar unsorted glacial debris
Qpu2b	Upper Pleistocene Snake Plain lava flows
Qs	Quaternary surficial cover
TR	Triassic shallow-marine to non-marine sediments of eastern Idaho
Tei	Eocene intrusions
Tpd	Pliocene stream and lake deposits
Tpf	Pliocene silicic welded tuff ash and flow rocks
Tpv	Pliocene volcanic units

[a] GIS coverage changes at state lines due to different state descriptions for geological types. Various agencies are working to have the descriptions the same for all areas.

The Albion Mountain Range is well known among geologists for its areas of sheared mylonites. This Cassia granite began as molten magma long after the Rocky Mountains formed, during early Tertiary period. They formed along fault zones at a level so deep within the continental crust that the rocks were hot enough to deform by flowing, like modeling clay, instead of through breakage. These mylonites appear to outline an area of deep-seated rock that rose as the overburden moved off along the mylonite fault zones. The Sublett and Black Pine Mountains probably contain the rocks that moved off the mylonite. If so, those rocks moved east at least 50 miles. Geologists call such structures metamorphic core complexes and their age is difficult to date. The mylonites in the area are probably somewhere between 20 and 40 million years old (Alt and Hyndman 1989).

Subbasin Soils and Soil Erosion

Soil orders within the ecoregions of the Raft River Subbasin are described in Table 15 with their corresponding erosion potential, which can effect the water quality of streams.

Table 15. Soil orders of the Raft River Subbasin[a].

NRCS[b] Soil Orders	Soil Genesis	Soil Development	Potential Natural Vegetation	Erosion Potential
Aridisols (Lower Elevations)	Arid soil (clayey soils)	Dry environments not subject to intensive leaching.	Sagebrush, desert shrub,shrubgrass, saltbush-greasewood, juniper-pinyon, woodlands, wheatgrass, buffalo grass, short grasses.	High potential to erode. Generally < 15% slope.
Entisols (Lower Elevations)	Recent soil (clayer soils)	Formed from natural events such as floods, landslides, or erosion. Occur in combination with Aridisoils.	Rangeland. They may be forested or used for cropland.	Steeper slopes are erodible. Generally < 20% slope. Lack of significant profile development.
Mollisols (middle Elevations)	Soft soil (clayer soils)	Formed and developed under prairie vegetation.	Grassland environments. They may be used for croplands and agricultural soils. Both short and tall grasses.	Low to moderate erosion potential. Generally < 20% slope
Inceptisols (Middle Elevations)	Beginning soil (clay soils)	Productive soils developed from volcanic ash.	Agricultural wheat lands developed from more productive grasslands and rangelands.	Generally < 25% slope. Profile development is more than Entisols by less than other orders
Alfisols (Higher Elevations)	Nonsense soil (cool to cool soils)	Formed under forest vegetation with significant weathering, although grass is the native vegetation in some areas.	Forest vegetation, tall grasses, some agricultural soils.	Generally < 10% slope. Low to moderate potential to erode.

[a] From USFS 1994 in consultation with BLM, NRCS, and the Big Wood River Subbasin Assessment (Buhidar 2001).
[b] U.S. Department of Natural Resource Conservation Service.

The primary soil orders described in Table 15 provide a good description of the type of soil that may contribute erosional sediment to water bodies based on the extent of their disturbed conditions and their surface slope (Buhidar 2001).

Generally average soil slope provides a gage of the potential soil erosion, or risk erodibilty. The USGS topographic maps show that slopes are low (0-9 percent) in the valleys and plains and gradually increase as one approaches the bordering mountain ranges. Slopes are steep in the mountain ranges, exceeding 30 percent in places.

The K-factor is the soil erodibilty factor in the Universal Soil Loss Equation (Wischmeier and Smith 1965). The factor is comprised of four soil properties: texture, organic matter content, soil structure, and permeability. The K-factor values range from 1.0 (most erosive) to 0 (nearly non-erosive). As seen in Figure 12, the weighted average K-factors range from very low on the flat interior slopes of the plain, to quite high on the friable soils in the Heglar area. On the steeper, but rocky, unweathered slopes of the mountains the erosion potential is moderate.

The soils in the Raft River Watershed formed from residual, alluvial, colluvial, lacustrine, and eolian parent materials. These materials derive from rocks ranging in age from the late Precambrian Harrison series found in the Albion and Middle Mountain to recent alluvium along the Raft River. The soil in the Sublett Mountains developed in alluvium and colluvium which were derived from limestone of the Mississippian Age. On the foothills and at the base of the Sublett and Blackpine Mountains are seep deposits of loess and silty alluvium from the loess deposited on the adjacent mountains. The soils developed in this silty material are represented by the Heglar, Rexburg, and Ririe series. The soils in the Cotterel and Jim Sage Mountains developed in alluvium and colluvium derived primarily from rhyolite with some loess influence (SCS et al. 1991). See Figure 13 for basic Raft River Subbasin soil subsections.

The clayey soils found in the subbasin lend themselves to furrow erosion in middle and lower elevation agricultural areas in alluvial terraces and low plateaus. Three types of soil erosion occur in the subbasin: sheet, rill, and furrow. “Sheet and rill erosion occurs on cropland when rainfall or snow melt occurs on sloping fields that are unprotected by crop residues or rough soil surface conditions and is found on non-irrigated croplands. Much of the eastern side of the Raft River Valley is dry farmed with the exception of the Sublett Creek area and the north and eastern sections of the valley. Sheet erosion occurs when a thin layer of soil or rough is detached or separated from the soil surface by water moving over the surface and then transported down slope” (NRCS 1998). Irrigation in the valley can produce furrow (irrigation induced) erosion. This occurs primarily on surface or furrow-irrigated cropland with fine textured soils. This type of erosion can also occur under sprinkler irrigation. “When irrigation water is applied to crops it detaches soil particles from the soil surface and transports it off site. Proper management of irrigation water in terms of volume, length of time, and related agronomic practices influence erosion” (NRCS 1998).

Gully erosion, in cropland soils of the Raft River Watershed, predominantly occurs on the fan slopes of the valley floor. The process occurs during intense summer thunderstorms. Soil erosion is more common on croplands of bare soils, soils that are summer fallowed, or soils that are planted to winter wheat that have spring thaw runoff or frozen soil runoff.

Classic gullies occur in numerous areas in the watershed, most particularly in well-defined drainages such as the Heglar Canyon area, and form incised permanent channels. There are many miles of classic gullies and most originate on the steeper non-irrigated uplands then slice

The main Raft River channel exhibits frequent bank erosion, especially in areas where grazing and trampling occur along the stream. In these areas the riparian habitat no longer exists or is severely degraded. Bank erosion also occurs in areas that have had stream alteration, such as channel straightening or bank armoring. In many of the tributaries in the subbasin, little or no riparian habitat exists along the channels and stream banks. In many cases, farming operations continue directly into the channel area. Much of the Raft River that lies within the Utah section of the subbasin has good riparian areas, less stream bank erosion, and generally well vegetated shorelines that appear to be in stable condition (Etcheverry 2001). The Raft River Subbasin plateau is 38 percent of the total subbasin area. Most of the Idaho section of the Raft River flows through this plateau. Fluvial areas also contribute to the overall subbasin sedimentation (See Figure 11). Further breakdowns for the Raft River Subbasin subsection are shown on Figure 13.

The Raft River rarely contributes direct flow to the Snake River during the summer because of water consumption by upstream irrigation. These rare discharges; however, have been estimated to bring considerable sediment and nutrients to the Snake River when they do occur. It has been estimated that when discharges occur, an annual loading of 900 tons of phosphorus, 840 tons of nitrogen, and 10-35 tons of sediment/acre/year are deposited into the Snake River from the Raft River Subbasin (SCS et al. 1991).

Subbasin Topography

The Raft River Subbasin is cartographically covered by 1:24,000-scale and higher USGS topographic quadrangle maps. Lands surrounding the Raft River Subbasin (Idaho and Utah) has two dominant subsections, which are the Great Basin and the Jarbidge High Mountain Ranges. The dominant landforms are glaciated mountains, fluvial mountains, plateaus and escarpments, and depositional lands. Slope gradients average 40 to 70 percent on the glaciated mountains and the fluvial mountains, 0 to 30 percent on the plateaus and depositional lands, and are near vertical on the lands surrounding the Raft River (Figure.14).

Subbasin Plant and Animal Characteristics

This section describes the plant and animal characteristics of the Raft River Subbasin relative to vegetation; wetlands/riparian areas; fisheries; wildlife; macroinvertebrates; and threatened, endangered, and sensitive species.

Subbasin vegetation

The vegetation on public USFS and BLM lands of the Raft River Subbasin can be categorized into two general categories: vegetation at the lower-to-middle elevation areas and vegetation at the middle-to-higher elevation areas. Generally these are broad categories that link to the area's ecoregions and to the natural and/or disturbed hydrology of the ecoregion.

Vegetation communities in the lower/middle elevations include sagebrush, riparian, and grasslands.

1. The sagebrush and grassland vegetation community includes cheatgrass, meadow grass, wheatgrass, mixed shrubs, rabbitbrush, and several sagebrush species. In other areas of the lower valley bottoms, where low shrub wetlands exist, shrubby cinquefoil, chicken sage, silver, big, fuzzy, and alkali sagebrush occur along various streams, springs, and vernal wetlands (USFS 1997).

2. Vegetation communities associated with riparian habitat includes tall willow shrublands associated with high gradient channels at lower elevations. Various other willow species exist in several of the riparian areas including coyote willow, whiplash willow, mountain alder, and water birch (USFS 1997).

Vegetation communities in the middle/higher elevation areas include forested vegetation, scrub-shrub vegetation, and emergent (herbaceous) vegetation.

1. The natural forest vegetation of the Sublett Mountains, Black Pine Mountains, Raft River Mountains, and Albion Mountains at higher elevations includes aspen, black cottonwood, Douglas fir, subalpine fir, Engelmann spruce, willow, juniper, and occasionally aspen. Some plant species found in the forests of the area that require moist sites are huckleberries, buckbrush, alder, and some sagebrush species (USFS 1997).

2. In the higher elevation wetlands and riparian areas, emergent (herbaceous) vegetation is dominated by sedges and sedge-like species including beaked sedge, water sedge, Nebraska sedge, clustered field sedge, soft-leafed sedge, softstem sedge, and common spikegrass (USFS 1997).

Subbasin Wetlands/Riparian Areas

Riparian areas are water-dependent systems that occur on lands adjacent to streams and rivers. Their occurrence is related to the interaction between stream channels and valley bottoms. Water that infiltrates into the riparian floodplain during periods of high flow returns to the channel during periods of low flow, which contribute to a source of cool summer flow for many streams. The inundation of the floodplain of a riparian area during flood stages reduces water velocities downstream and aids in reducing the risk of channel erosion. The stored ground water recharge is then released slowly in the dry season. The vegetation associated with the wetlands shades and helps moderate water temperatures. These areas provide a critical refuge for a variety of aquatic species and rearing areas for juvenile fish. Vegetation along streams buffers against inputs of sediment from hillsides and adjacent lands.

In the Raft River Subbasin, as in many areas of the west, the frequency and extent of seasonal floodplain and wetland inundation have been altered by changes in flow regimes. These changes include diversions, ground water withdrawals, modification in channel geometry due to sedimentation and erosion, channelization, and road building. Riparian areas and wetlands are subject to increasingly concentrated and competing resource demands. These demands include mineral, sand, and gravel extraction; human settlement; water withdrawal; agricultural practices; livestock use; wildlife; and recreation. Riparian areas and wetlands in the Raft River Subbasin encompass approximately 1,617 hectares (4,000 acres) of the total of 356,164 hectares (880,100 acres) in the subbasin. This is less that 1 percent of the total land in the subbasin and therefore amounts to a minimal percent of the land use. All of the wetlands and riparian areas are dependent upon the waters of the Raft River and its tributaries for their existence.

Most of the remaining wetlands/riparian areas that exist along the Raft River have willow strips and wet meadows that primarily are used for grazing and hay production. Most of the riparian shrubs are severely impacted by man either through livestock grazing or clearing for pasture or native hay. The lack of water flow now in many sections of the Raft River has eliminated miles of wetlands and riparian areas. A few rare areas of only about 40 surface hectares (100 acres) exist in a total of two to three wetlands along the lower Raft River. At the mouth of the Raft River at the Snake River an area of 1,200 to 1,600 hectares (3,000 to 4,000 acres) is impacted by floodwaters and a shallow water table which limits the use of the wet meadows to hayland pasture. Small depressions within this wetland at the mouth of the Raft River are supporting primarily hydrophilic vegetation such as cattails, rushes, grasses, and sedges (SCS et al. 1991).

Healthier areas of wetlands/riparian areas exist along some of the Raft Rivers tributaries. Some areas also exist in the Sublett Mountains along Sublett Creek, Fall Creek, Lake Creek, and Van Camp Creek. Other major areas of wetlands and riparian areas are around Cassia Creek above Malta (approximately 567 hectares total). These wetlands include wet meadows used as pastures and for native hay production. Riparian-scrub-shrub (willow) wetlands are also found along the creek and associated ditches in some areas; examples of these can be found in the Elba area. In some parts of the highlands, riparian areas along the creeks have reverted to near native conditions. In the area north and west of Almo, approximately 730 hectares (1,800 acres) exist along Almo Creek, Edwards Creek, and Little Cove Creek. Some current riparian restoration and good management practices in this area are helping restore the natural stream flow and riparian areas along Edwards and Almo Creeks (SCS et al. 1991).

Subbasin fisheries (general description)

There are many species of cold water fish in the streams and reservoirs of the Raft River Subbasin (Table 16). The various fish species found within the subbasin include rainbow trout, brown trout, brook trout, cutthroat trout, cutthroat/rainbow hybrid, kokanee, sculpin species, redside shiners, long nose dace, speckled dace, and sucker species such as the Utah and mountain sucker.

Raft River

Historically, the lower portion of the Raft River from Malta to the Snake River has had salmonid spawning. The river acted as a migration corridor for Yellowstone cutthroat, mountain whitefish, sculpin, dace, and suckers (IDFG 2001). Currently, neither a salmonid fishery nor spawning exist in this stretch of the Raft River. Sediment, channelization, irrigation diversions, and low to nonexistent summer flows are limiting factors to any potential fish populations.

The Raft River from the Utah line to Malta has a small fishery with limited spawning in some areas above The Narrows area. In higher flow periods there may be limited spawning with a small resident population of Yellowstone cutthroat and rainbow trout along with some non-game species (IDFG 2001).

Salmonid spawning and fisheries exist in many of the tributaries to the river and that section of the Raft River located in the Utah section of the Raft River Subbasin.

Table 16. Fish species and pollution tolerance in the Raft River Subbasin.

Species	Scientific Name	Tolerance[a]
Yellowstone cutthroat trout	*Oncorhynchus clarki bouvieri*	II
Rainbow trout	*Oncorhynchus mykiss*	II
Brown trout	*Salmo trutta*	MI
Brook trout	*Salvelinus fontinalis*	MI
Cutthroat/rainbow hybrid	*Oncorhynchus clarki X O. mykiss*	II
Kokanee salmon	*Oncorhynchus nerka*	II
Sculpin	*Cottus sp.*	
Utah sucker	*Catostomus ardens*	TT
Mountain sucker	*Catostomus platyrhychus*	MT
Shiners	*Richardsonius sp.*	
Longnose dace	*Rhinichthys cataractae*	MI
Specked dace	*Rhinichthys osculus*	MI
Leatherside chub	*Gila copei*	MT
Arctic grayling	*Thynallus arcticus*	II

[a] From DEQ 1996. Tolerance Value: II = Highly intolerant, MI = Moderately intolerant, MT = Moderately tolerant, TT = High tolerant

Sublett Area

The streams in this area are suitable for trout. Salmonid spawning occurs in the perennial tributaries of Sublett Reservoir, Sublett Creek, and Lake Creek (Fall Creek and Van Horn Creek are tributaries to Lake Creek). In these streams, cutthroat, rainbow, and brown trout all spawn. Sublett Reservoir has a drainage basin of approximately 117 square kilometers (km^2). The Sublett Reservoir has a population of cutthroat, rainbow, and brown trout, along with kokanee salmon. There is hatchery supplementation of game fish to the reservoir and, since 1990, there have been stockings of cutthroat trout, Henry's Lake cutthroat trout, kamloops strain of rainbow trout, Hayspur rainbow trout, kokanee, and brown trout. Riparian habitat along these streams contributes to the fishery in this area. Sublett Creek from Sublett Reservoir to the lower boundaries has a small fishery but the control of flow for irrigation demands create problems for the fish population.

Some seeps and small springs possibly support some resident populations of cutthroat and rainbow trout in the creek (IDFG 2001). Sublett Creek above the Sublett Reservoir has suitable habitat for spawning and early rearing although much of the stream appears silt-laden. The riparian zone is heavily grazed in some areas with little overhead cover present. In addition, the spring fed streams contain a heavy cover of macrophyte vegetation dominated by watercress. This situation is very common in spring-fed systems with small contributing watersheds. Some stretches of the stream have willows in abundance with good habitat/riparian zones. Idaho Department of Fish and Game (IDFG) indicate with their survey results that brown trout successfully move upstream at least 3 km from Sublett Reservoir for spawning and early rearing (Warren 2000).

Cassia Creek Area

Cassia Creek originates high in the Albion Mountains above Malta approximately 19 km south of the town of Albion. Through much of its length Cassia Creek flows through a broad valley vegetated primarily with sagebrush and agricultural lands. Numerous grain fields, pastures, and hay crop fields border the creek along much of the lower reaches. Much of the stream is utilized for agricultural purposes and is mostly dewatered in the lower reaches during the irrigation season. Livestock use of the riparian corridor is substantial. The riparian vegetation is typically willows, birch, and various shrubs and grasses. The fish habitat is abundant throughout much of Cassia Creek but sedimentation is substantial due to poor landuse practices.

Fish sampled by IDFG in 1987 were identified as rainbow, cutthroat, and brook trout; leatherside chub; longnose dace; and one unidentified sucker.

Spawning habitat, although natural reproduction is occurring, has been significantly affected by the sediment load rendering most potential gravel areas unsuitable for recruitment. Sediment is probably a direct result of poor landuse practices in the watershed. Runoff from agricultural lands, and, to a lesser degree, livestock grazing, has resulted in a substantial sediment problem in Cassia Creek (Grunder et al. 1987).

Cassia Creek, from Conner Creek to Raft River, has some fisheries in the first couple of miles downstream. There are some naturalized cutthroat and rainbow trout in the creek and hatchery fish additions to the site. Further down Cassia Creek through Malta and to the confluence with Raft River, irrigation diversions dry up the creek most years. Cassia Creek, from the headwaters to Conner Creek, has rainbow, cutthroat, and hybrid trout naturalized and spawning. The riparian habitat on Cassia Creek in this area helps provide streambank stability and stream shade and acts as a sediment filter strip along much of the stretch. It is generally rated as excellent by the IDFG. Other than sediment loads, other habitat parameters are in excellent condition. New Canyon Creek and Flat Canyon Creek (tributaries to the headwaters of Cassia Creek) both have salmonid spawning of rainbow and cutthroat trout fisheries (IDFG 2001).

Almo and Edwards Creek Area

Almo Creek is a third-order tributary of Raft River, originating in the Albion Mountains of the Sawtooth National Forest approximately 10 km northwest of Almo. The stream flows through a steep V-shaped canyon vegetated with sagebrush and juniper. Almo Creek then crosses a broad, flat valley (Big Cove). The riparian vegetation is dense and diverse, consisting primarily of willows, quaking aspen, birch, and Douglas fir. Some excellent fish habitat exists throughout the length of Almo Creek (Grunder et al. 1987). Irrigation diversions often dewater the lower sections during the irrigation season. Fish collections both in 1987 and 1999 by IDFG indicate cutthroat trout in the stream. Spawning habitat consists primarily of cobble-and boulder-sized particles; however, sufficient gravel areas exist for reproductive purposes. Sedimentation appears to be minimal (Grunder et al. 1987; Warren 2000). Some habitat restoration has been accomplished on Almo Creek and Edwards Creek and improvements are occurring. Additional work is planned in the area to complete a project funded by §319 Nonpoint Source Program cost share funding on these two creeks. Almo Creek and nearby Edwards Creek are not currently listed on the §303(d) list.

Black Pine Area

Two tributaries from the Black Pine area to Raft River are Eight Mile Creek and Six Mile Creek. Neither of these streams are listed on the §303(d) list.

Eight Mile Creek is a tributary of the Raft River and originates on the west side of the Black Pine Mountains. The creek flows down a narrow canyon with junipers and through a sparsely vegetated riparian area, consisting of junipers, sagebrush, and some willows. Overall habitat conditions are rated poor by IDFG. The stream flows for approximately 5 km before it enters a small irrigation compound just below the forest boundary. Recent fish collections were completed in 1987, 1996, and 1999 by IDFG personnel. The Yellowstone cutthroat trout in the stream have been identified as a population of pure strain of *Oncorhynchus clarki bouveri* by Robert Behnkes in 1986 (Grunder et al. 1987). This strain was verified by the other two IDFG samplings on the creek. The spawning habitat substrate appears abundant but fines in the gravel are a concern. Spawning is occurring on the stream but rearing and holding areas for trout are limited and ongoing sedimentation from the erosion of streambanks and adjacent slopes appears to be a problem.

Six Mile Creek is a tributary of the Raft River which also originates on the west side of the Black Pine Mountains. Approximately 1.5km of the stream is free flowing from its source at Six Mile Spring and flows through a V-shaped canyon vegetated with sagebrush, juniper and various species of grass and then into a small irrigation impoundment at the base of Six Mile Canyon. The riparian vegetation is sparse, consisting mostly of grasses and sagebrush. Most of the watershed is used for livestock grazing. Yellowstone Cutthroat trout have been documented in the past by IDFG and in 1999 cutthroats were found along with rainbow trout hybrids (Grunder et al. 1987; Partridge and Warren 1995; Warren 2000).

Raft River Utah Area

Several tributaries in the Raft River Watershed located in Utah have fisheries. For example, George Creek is a tributary and originates in the Raft River Division of the Sawtooth National Forest. The creek is normally diverted for irrigation demands and seldom reaches the Raft River. The lower section of George Creek has poor spawning habitat with fine silt as the primary substrate. The upper section of the creek’s headwaters possesses a population of cutthroat trout. Further discussions of the Utah fisheries will not be made in this document.

Independence Lakes

The Independence Lakes are located near Cache Peak at 3,170 m (10,399 ft). They are the only system of natural lakes on the entire southern division of the Sawtooth National Forest and are a popular recreation destination. Natural reproduction occurs in some of the lakes and they have had hatchery supplements in the past of rainbow trout, cutthroat trout, California Golden trout, and Arctic grayling.

Subbasin Wildlife

With the many varied and mingled areas of forest/woodlands, rangeland, cultivated fields, and water habitat, food and cover is provided for many mammals, birds, and fish. The populations are largely determined by the suitability of the habitat; that is, the supply of food, cover, and water.

Mule deer are the most abundant of the big game animals in the subbasin, but there are also small populations of pronghorns in the area. Recently elk and moose have had an increase in population in the Sublett area. Beaver, mink, muskrat, and other small furbearers live along the streams. Much of the mule deer, elk, and moose summer activity within the Raft River Subbasin occurs on the Sawtooth National Forest or other public lands. The major use of private land by these species occurs during the winter for food and cover. Crucial deer winter range in the basin amounts to approximately 73,000 acres on the state, private, and BLM lands within this area. These essential areas have supported up to approximately 6,100 deer during the winter months. Pronghorn are limited to a small area within the Raft River Subbasin. The pronghorn inhabit the area on a yearlong basis, shifting within the area as food and water conditions dictate (SCS et al. 1991).

The Raft River area has a variety of upland game species that inhabit the different habitat types. On private lands pheasant, morning doves, and quail are prevalent. Others such as the sage grouse, Hungarian partridge, chukkar partridge, and rabbits are dependent on the rangelands of the BLM and USFS. Various forest grouse species live on the forestlands of the Sawtooth National Forest.

Waterfowl in the Raft River Subbasin, as a group, are found throughout the area. The Raft River itself does not offer a great deal of waterfowl habitat due to limited amounts of open water and riparian habitat. Waterfowl use is predominantly in the upper part of the subbasin near the Snake River/Lake Walcott areas. A U.S. Fish and Wildlife Service (USFWS) wildlife refuge on Lake Walcott provides habitat for the area waterfowl. The watersheds to the south provide feeding areas for the waterfowl in the area. The northern area also provides winter habitat for migrating waterfowl along the Snake River flyway. Mallards, teal, shovelers, pintails, and mergansers are found in the northern sections and to a lesser extent in the Sublett area and along the various tributaries. Significant numbers of Canada geese are common and frequent the grain fields located in the subbasin. Snow geese pass through the basin in the spring and fall.

Many bird species can be found in a number of general terrestrial habitats (riparian, grassland, sagebrush) located on lower and middle elevation public land areas. Riparian habitat species include prairie falcon, merlin sage grouse, Lewis' woodpecker, yellow warbler, dusky flycatcher, willow flycatcher, Wilson's warbler, Swainson's thrush, and others. Grassland habitat species include the northern harrier, bobolink, and grasshopper sparrow. Sagebrush habitat species include prairie falcon, merlin, sage grouse, gray flycatcher, loggerhead shrike, brewer's sparrow, sage sparrow, and others. All of these species respond positively or negatively to changes in habitat conditions or habitat structural components by land uses such as grazing.

Subbasin Macroinvertebrates

DEQ has developed a multi-metric index of macroinvertebrate communities called the Stream Macroinvertebrate Index (SMI) to use as an indicator of stream health (Grafe et al. 2002). The SMI assesses the status of aquatic life beneficial uses in wadeable streams and large rivers in Idaho. Macroinvertebrate species vary dramatically in their tolerance to temperature, pollutants, and sediment in the water and in the substrate of streams. Water quality determinations can be made following the identification of the composition of macroinvertebrate populations in the sample area, determining relative abundance, and determining other population or life history traits.

The insect orders used for description of water quality include Ephemeroptera (mayflies), Plecoptera (stoneflies), Trichoptera (caddisflies), and Diptera (true files). Other insect orders utilized might include Coleoptera (Beetles), Lepidoptera (butterflies and moths), Neuroptera (lacewings), Hymenoptera (ants, bees, and wasps), and Hemiptera (true bugs).

Subbasin Threatened, Endangered, and Sensitive Species

Within the Raft River Subbasin, there are several state and federal agencies that list species of special concern; candidate species; or endangered, threatened, and sensitive species. The USFWS is the main (nonanadromous, nonmarine species) listing agency. The USFWS lists 21 animals and three plants as endangered, threatened, or as candidate species within the state of Idaho (Table 17) (*http://ecos.fws.gov/webpage/webpage_region_lists.html?lead_region= 1*). However, in Cassia County there are only seven listed species with three additional candidate species. Of these 10 species four are aquatic, plus one semiaquatic plant. Three of the animals are snails that are found only in the mainstream of the Snake River and as such are not influenced by activities within the Raft River Subbasin. Therefore, the only federally listed aquatic plants and animals that will be influenced by the SBA or TMDL would be the spotted frog (*Rana luteiventris*) and the Ute ladies' tresses (*Spiranthes diluvalis*).

Table 17. Threatened and endangered species in the Raft River Subbasin.

Species Common Name	Scientific Name	Comments
Spotted frog	*Rana luteiventris*	Considered the Great Basin sub-population of the Columbian spotted frog. Determined that listing was warranted in 1993. Currently a candidate species.
Ute Ladies-tresses	*Spiranthes diluvalis*	Recognized as a distinct species in 1984. Listed as threatened in 1992.
Canada lynx	*Lynx canadensis*	Proposed for listing as threatened.
Gray wolf	*Canis lupus*	Currently listed as endangered.
Bald eagle	*Haliaeetus leucocephalus*	First protected in 1966 by the Endangered Species Preservation Act. Listed in 1973 under the Edangered Species Act. Down listed from endangered to threatened in 1995.
Utah valvata snail	*Valvata utahensis*	Listed as endangered in 1992.
Snake River physa snail	*Physa natricina*	Listed as endangered in 1992.
Bliss Rapids snail	*Taylorconcha serpenticola*	Listed as threatened in 1992.
Christ's paintbrush	*Castilleja christii*	Candidate species
Yellow-billed cookoo	*Coccyzus americanus*	July 2001, U.S. Fish and Wildlife Service published findings that indicated the yellow-billed cookoo should be listed. Other priorities preclude this listing; therefore, it is considered a candidate species. (This information is not on current USFWS Web site listed above)

The Ute ladies' tresses has the potential to be found in wet meadows, along riparian zones and in other wetlands (USFS web page 2001). The spotted frog is an aquatic animal found in and near streams, lakes, marshes, and ponds. The spotted frog frequents these aquatic habitats in mixed coniferous forests, subalpine forests, grasslands, and sage and rabbitbrush shrublands (Stebbins 1985). Management decisions, as a result of the SBA-TMDL, will need to address these two species and may affect upland species as well. These too will need to be addressed in any implementation plans developed by state and federal land management agencies.

In addition to the listed and candidate species, the USFS through the USFWS maintains a list of interested, or watch, species. These plants and animals are those that are not listed but that the USFWS suggests that the federal agencies consider in their management and planning activities. The Sawtooth National Forest contains 37 species found on this list.

The IDFG also maintains a statewide list of species of special concern (Table 18). Many of the species on this list are duplicates of those listed by the USFWS and other federal agencies. However, the list does not contain plant species. A list of the IDFGs species of special concern can be found at *www2.state.id.us/fishgame/info/nongame/ngconcern.htm.*

Table 18. Raft River species of special concern.

Idaho Department of Fish and Game Species Of Special Concern			
Species Common Name	**Scientific Name**	**Species Common Name**	**Scientific Name**
California bighorn sheep	*Ovis canadensis californiana*	Ferruginous hawk	*Buteo regalis*
Pygmy rabbit	*Brachylagus idahoensis*	Black tern	*Chlidonias niger*
Townsend's big-eared bat	*Corynorhimus Townsendii*	Long-billed curlew	*Numenius americanus*
Long-eared myotus	*Myotis evotis*	Greater sage-grouse	*Centrocercus urophasianus*
Cliff chipmunk	*Tamias dorsalis*	Northern goshawk	*Accipiter gentilis*
Little pocket mouse	*Perognathus longimembris*	Trumpeter swan	*Cygnus buccinator*
Western small-footed myotis	*Myotis ciliolabrum*	Western toad	*Bufo boreas*
Leatherside Chub	*Gila copei*	Northern leopard frog	*Rana pipiens*
Yellowstone cutthroat trout	*Oncorhynchus clarki lewis*	Columbia spotted frog	*Rana luteiventris*
Davis wavewing	*Cymopterus davisii*	Common garter snake	*Thamnophis sirtalis*
Slender moonwort	*Botrychium lineare*	Short-horned lizard	*Phrynosoma douglassi*

The USFWS and the IDFG are interested in additional plants and animals as well as where there are concerns about the population status and threats to their long-term viability. These species have no legal status under the Endangered Species Act. However, in context with ecosystem-level management these species and their habitats should be considered in the TMDL implementation processes.

1.3 Cultural Characteristics

The population, land use and land ownership, agriculture, forestry, rangeland, mining, recreation, roads, rural development, and economic growth all characterize various management practices in the Raft River Subbasin that can affect water quality. The majority of the subbasin lies within Cassia County. Figure 15 shows the Raft River Subbasin county coverage.

Raft River Subbasin Ownership

Land ownership in the Raft River Subbasin is shown in Table 19 and Figure 16 for combined land ownership in both the Idaho and Utah sections of Raft River HUC 17040210.

Table 19. Raft River Subbasin land ownership.

Fourth Field HUC[a]	LAND USE	US FOREST SERVICE	RANGE (BLM)[b]	PRIVATE	STATE LAND[c]	US FISH AND WILDLIFE	WATER	TOTAL
Raft River	%	20	31.8	45.2	2.9	0.0	0.0	100
17040210	Sq. Miles	303	481	684	43.8	0.090	0.24	1512
USGS[d]	Acres[e]	194,033	308,025	437458	28058	61.4	154.1	967,789

[a] HUC = Hydrological unit code.
[b] Bureau of Land Management.
[c] Private = agriculture land and includes dryland, irrigated-gravity flow land, irrigated sprinkler land, and grazing lands. Urban areas are also included in private lands.
[d] U.S. Geological Survey.
[e] one square mile = 640 acres...

Raft River Subbasin Land Use

Land use in the Raft River Subbasin is additionally broken down into categories as listed on Figure 17 and Table 20 (White Horse Associates 1999; from USGS 1:250 K Land Use and Land maps).

Table 20. Land Use categories and percentage of land in the Raft River Subbasin.

Land Use	Percent Of Area
Commercial Services	0.03
Confined Feeding Operations	0.04
Cropland and Pastures	25.04
Deciduous Forest Land	0.17
Evergreen Forest Land	13.21
Forested Wetlands	0.07
Herbaceous Rangeland	2.66
Industrial	0.06
Lakes	0.00
Mixed Forest Land	11.69
Mixed Rangeland	43.27
Mixed Urban or Built-up Land	0.03
Nonforested Wetlands	0.37
Other Agricultural Land	0.06
Reservoirs	0.02
Residential	0.00
Shrub and Brush Rangeland	2.84
Streams and Canals	0.02
Strip Mines, Quarries, and Gravel Pits	0.05
Transportation, Communications	0.38

History

The Raft River Valley had its first permanent settlements around the present area of Malta. The natural lush green meadows along the Raft River attracted cattlemen during this period. The first cattle were brought into the area during the spring of 1868. Small-scale farming began in the Raft River Valley in the late 1870s. These small operations were usually located along the various streams because of the availability of water for irrigation. Small irrigation diversions were made to distribute the water over the fields. The first major crops were grain, alfalfa, and pastures for cattle. By the late 1880s, large tracts of acreage that could be served by diversion of surface flows from the Raft River and its principal tributaries were developed for agriculture use. By this time, nearly all available surface water was appropriated.

By legislative act in 1879, Cassia County was created and Albion was chosen as the county seat. Albion remained the county seat until 1908 when the town of Burley, on the Snake River and near the railroads, became the county seat.

The Reclamation Act of 1902 marked the beginning of rapid expansion of agriculture in Minidoka and Cassia countries. Development of large irrigation projects such as dams and canal systems along the Snake River brought about rapid expansion of agriculture around the communities of Burley and Rupert.

It was during the 1910s that both cattlemen and homesteaders flocked into the valley. Non-irrigated (dryland) farming operations started around the turn of the century. In several isolated areas where rainfall was sufficient, dryland farming became economical. Dry land farming remains a large part of the agriculture economics in the Raft River Subbasin.

Pumping ground water for irrigation in the Raft River Valley started in the 1920s, but it was not until about 1950 that the large-scale pumping began for supplemental irrigation and the irrigation of large tracts remote from surface supplies. With electric power already in the valley, many wells were developed and agriculture expanded. Sprinkler irrigation equipment was introduced in the early 1960s and helped increase the rate of agricultural development since topography did not create problems for proper irrigation.

Continued new and increased use of the ground water resource continued in the early 1960s with attendant aquifer water-level declines. The potential effect of these declines on established water rights caused the Idaho State Reclamation Engineers to close the basin in July of 1963 to further application to appropriate ground water for irrigation (The Raft River Subbasin Idaho-Utah, as of 1966, USGS).

Population

The Overall population in Cassia County has increased approximately 20 percent from 1970 to 2000. Table 21 shows overall growth from 1970 through 2000 (IDC 2001 web page).

Table 21. Cassia County population estimate.

YEAR[a]	URBAN	RURAL	COUNTY TOTAL
1970	8,154	8,863	17,017
1980	8,528	10,899	19,427
1990	9,810	9,722	19,532
1998	10,566	10,793	21,359
2000	10,545	10,871	21,416

[a] 1970 and 2000 rural and urban estimates were based on the average value of 1980-1998 based on an average rural to county ratio of 1:1.92.

The populations of cities in Cassia County in 2000 were Burley, 9,316; Declo, 338; Albion, 144; and Oakley, 668 (IDC 2001). Most of the population of the Raft River Subbasin is rural except for small urban areas including Malta (population 177 [IDC 2001]) Elba, Almo, and Naf. Approximately 2,000+ people reside in the watershed (SCS et al. 1991).

Economics, Principal Activities

Agriculture is the major local industry in the Raft River Subbasin. It is comprised of farms that encompass crop production (both dryland and irrigated land) and animal production. Farming is the major economic base of the area where cereal crops, alfalfa, field corn, sugar beets, pasture, blue grass for landscaping, and potatoes are grown. Livestock operations include cattle and sheep ranches. Confined animal feeding operations (CAFO's) have become major industries in the area, with a major livestock feeding operation, several large dairies, mink farms, and hog farms. However, the number of farms in much of the area is decreasing. For example, the number of farms in Cassia County has changed from 870 in 1982 to 729 in 1997 (Idaho

Agricultural Statistics, Idaho Agricultural Statistics Survey, Idaho Department of Agriculture, Boise, Idaho and http://www.nass.usda.gov/id/).

Although the number of farms are decreasing throughout the county, there has been an increase in growth of livestock numbers over the last 12 years (Table 22) (Idaho Agriculture Statistics, Idaho Agricultural Statistics Survey, Idaho Department of Agriculture, Boise, Idaho and http://www.nass.usda,gov/id and http://www.nass.usda.gov/id/publications/county%20estimate/coesttoc.htm#livestock). The number of livestock in Cassia County includes all beef and dairy cows that have calved, along with calves, bulls, steers, and heifers. With the increase of dairies in the area a percent of dairy stock are dry at any one time and replacement heifers are always being raised.

Table 22. All cattle, calves, and sheep in Cassia County.

Year	All Cattle and Calves	Beef Cows Calved	Dairy Cows Calved	Other Cattle	Sheep and Lambs
1990	116,000	27,500	8,400	80,100	12,000
1996	144,000	27,000	12,000	105,000	10,000
2001	169,000	26,500	19,000	123,500	14,000
Growth index ratio[a]	1.46	0.96	2.26	1.54	1.17

[a] Growth Index Ratio = value for 2001 divided by value for 1990

Subbasin Forestry

The Sawtooth National Forest comprises more than 2.1 million acres of public land, most of it in southcentral Idaho, with one section located in the Raft River Subbasin in Utah. The headquarters are located in Twin Falls, Idaho. The forest is made up of four administrative units. These units include the Minidoka, Ketchum, and Fairfield Ranger Districts and the Sawtooth National Recreation Area.

Trees in the forest provide homes for wildlife and a pleasant visual backdrop for visitors and residents. In the Raft River area every year trees are harvested for firewood, posts, poles and Christmas trees. Some timber sales have occurred in the recent past on the east side of Black Pine Mountain. Forest Service plans have called for some selective harvesting of pines and replanting of aspen trees to improve the aspen forest in the area. In addition to providing for harvest, the timber country also provides habitat for game and non-game animals. Non-game animals include beaver, river otter, mountain bluebirds, blue jays, grey jays, red-tailed hawks, and golden and bald eagles. Furthermore, cattle and sheep graze on this National Forest in most areas.

Subbasin Rangeland

Generally, rangeland grazing in the Raft River Subbasin can be divided into by two groups. The first is grazing on public lands such as those managed by BLM, USFS, and Idaho Department of Lands (IDL) (state owned lands which encompass the equivalent of two sections in every township in Idaho). The second group is grazing on private lands, which may include individual pastures, or can be intermingled with or interdependent on the public grazing lands in the watershed. Rangeland grazing is a major agricultural industry in the Raft River Subbasin and is predominantly managed by the BLM and USFS. It is estimated that 51.8 percent of the land is owned and managed by one of these federal land management agencies. The remainder of the land is owned by the state or privately held with small amounts administered by other federal agencies (White Horse Associates 1999).

Subbasin Mining

Mining development has existed in the Raft River Subbasin since the early pioneers arrived in the area. Several of the mines were placer mines for gold or uranium. Most mining sites were mining claims with minimal development. Some rare earth mines have existed at one time for iron, titanium, zirconium, thorium, uranium, and beryllium in the Almo Basin and City of Rocks areas. Large mining developments such as the Pegasus Gold Mine (on the west side of the Black Pine Mountains) do not exist in the area. However, sand and gravel-mining sites are common in the watershed. In addition, some crushed rock pits are also located in the subbasin. Geothermal mining was once explored at a government-sponsored site in the area, but was later abandoned.

Subbasin Recreation

Generally, traditional recreation in the Raft River Subbasin has consisted of hunting for big game such as mule deer, elk, moose, mountain lion, and antelope. The area also offers wing shooting for ducks, geese, chukker, Hungarian partridge, pheasant, sage grouse, and forest grouse. The area offers fishing, camping, hiking, motorized trail use, and horseback riding, along with mountaineering in the City of Rocks area. The City of Rocks National Reserve is an area of unique granite formations and a landmark on the California Trail with historic trail remnants still visible. The various recreation opportunities available at the reserve have made the area popular as a tourist area. The last three years (1999-2001) have seen approximately 80,000 visitors per year. The Pomerelle Mountain Resort on the edge of the subbasin, located on Mount Harrison, offers snow skiing, snow boarding, and cross county skiing. Many groomed snowmobile and motorized trails exist within the subbasin. The area around Mount Harrison has become famous for hang-gliding and other aerial pursuits. The Skyline Trail that runs from the top of Mount Harrison to Independence Lakes and on to the City of Rocks National Reserve is popular with hikers, mountain bikers, and horseback riders. Recreational pursuits have become more important to the economy of the Raft River Subbasin.

Roads

Roads may be a source of sediment in the Raft River Subbasin and may effect the water quality of adjacent streams. Roads that parallel streams such as Lake Creek, Fall Creek, Van Camp Creek, and Sublett Creek in the Sublett area could introduce sediment to the streams. Roads that go into the mountains above Cassia Creek may also introduce sediment into Cassia Creek and its tributaries. Most road construction sediment is produced within the first three years of life on the road, but may continue at a significantly reduced rate for longer periods (USFS 1989). Figure 18 shows towns and major roads in the Raft River Subbasin.

Existing Local Government and Civic Groups Working in Water Quality Issues

The watershed covers an area of approximately 880,100 acres in Idaho and Utah, of which about 44 percent is privately owned. Of this acreage, about 174,200 acres are farmed. The NRCS estimates all the acreage has an average soil loss of over 10 tons/acre/year with the worst case potential soil loss at 35 tons/acre/year. Sediment delivery rates are high for the cropland and most of it lies close to the Raft River. The delivered sediment causes flooding problems in the area. It also causes water quality problems for tributaries, the Raft River, and Lake Walcott.

Local government and civic groups include the local highway district, East Cassia and West Box Elder (Utah) Soil Conservation Districts, Raft River Flood Control Districts No. 15, City of Malta, Cassia County Commissioners, and the Raft River Rural Electric Cooperative. They have all be involved in addressing four basic resource problems. These groups have identified these problems as:

1. Flooding of the Raft River and the Cassia Creek area.
2. Severe soil erosion on cropland.
3. Inadequate irrigation water supply.
4. Degraded water quality of the lower Raft River and Lake Walcott.

The objectives of the groups listed above are to:

1. Identify alternative treatment measures that will reduce or eliminate flooding, severe erosion, and sedimentation problems.
2. Identify any feasible solutions that would improve the irrigation water supply.
3. Identify available programs that could assist in the implementation of selected evaluation alternative solutions (SCS et al. 1991).

These problems and objectives will be further defined in the Raft River Implementation Plan. The East Cassia Soil Conservation District, along with support by the NRCS, has worked with agriculture interests on many projects for sediment control and water quality.

The Walcott Watershed Advisory Group (WAG) along with a Raft River Committee affiliated with the WAG is becoming active in the subbasin by working with DEQ on the TMDL process.